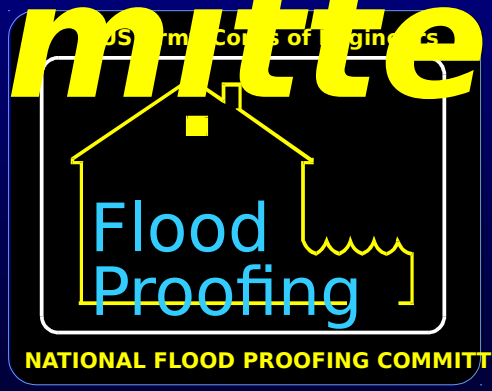
US Army Corps of Engineers®

National Nonstructural/ Flood Proofing Committee



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Team

- Kenneth Zwickl, HQ
- Larry Buss, Omaha District
- Falcolm Hull, New Orleans District
- Carol Halloway, Galveston District
- Gene Barr, Huntington District
- Chris Mack, Charleston District
- Clark Frentzen, South Pacific Division
- Joseph Remondini, Tulsa District
- Joseph Wanielista, Detroit District
- Mark Harberg, Southwest Division
- Stuart Davis, Institute for Water Resources

US Army Corps of Engineers
Flood Proofing
NATIONAL FLOOD PROOFING COMMITTEE

US Army Corps of Engineers®

US Army Corps of Engineers
Flood Proofing
NATIONAL FLOOD PROOFING COMMITTEE

Mission

- Flood Proofing
- Non-Structural

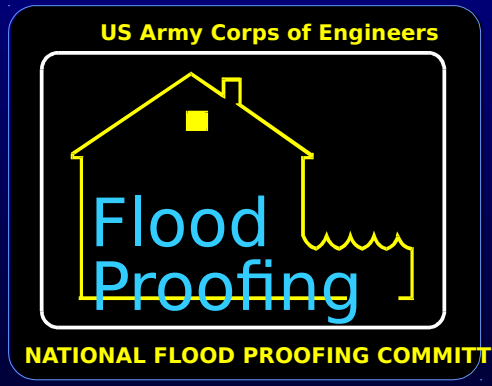
US Army Corps of Engineers®

Vision for the Future in Flood Management Within the Corps of Engineers

- Equal Consideration for All Measures (Use All Tools in the “Tool Box”)
- Comprehensive Approach
- Use all opportunities
  - Flood Damage Reduction
  - Ecosystem Restoration
  - Recreation
- No Adverse Impacts
- Partnering
- Innovation
- Leadership

US Army Corps of Engineers®

What does this all naturally lead to?



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Maximizing the Use of Non-Structural Measures

Key Words to Provide Focus

- Opportunities
- Impacts
- Innovation
- Challenges
- Excitement

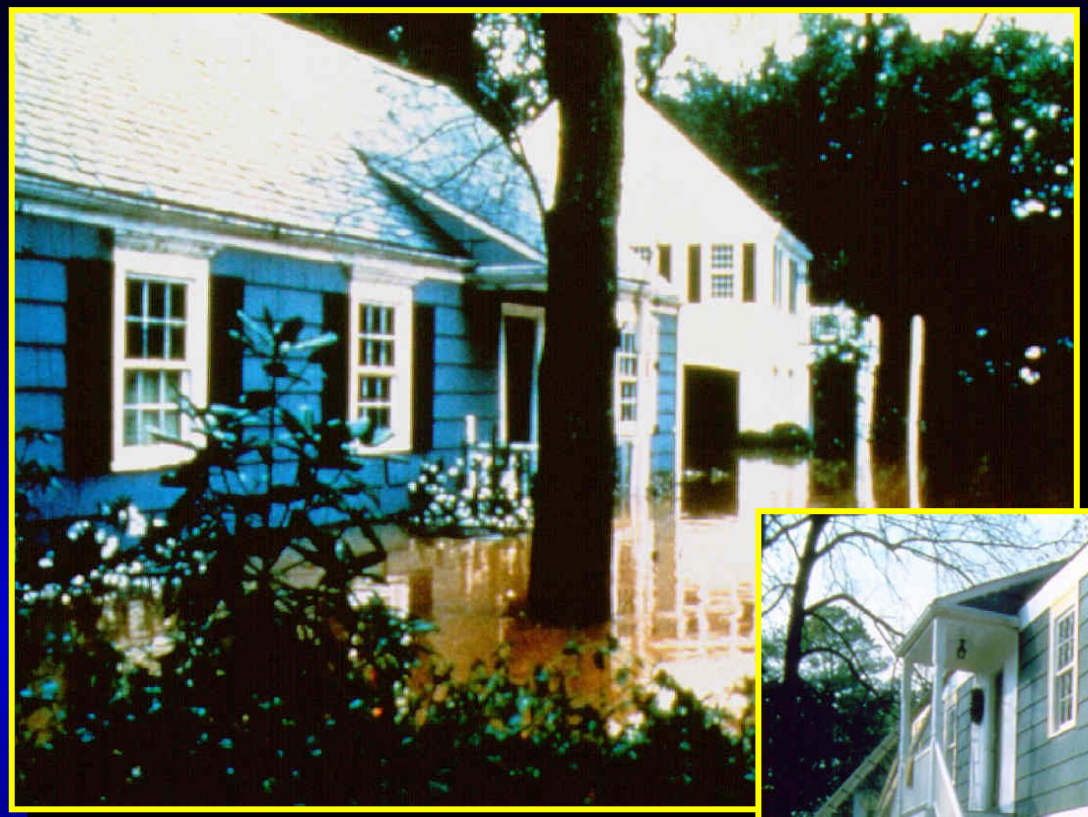
Workshop Components

- Non-Structural Measures
- Measure evaluation
- Policy/Guidance
- Plan Formulation
- Alternative Evaluation
- Plans and Specs
- Implementation
- Specific Nonstructural Project

Nonstructural Measures

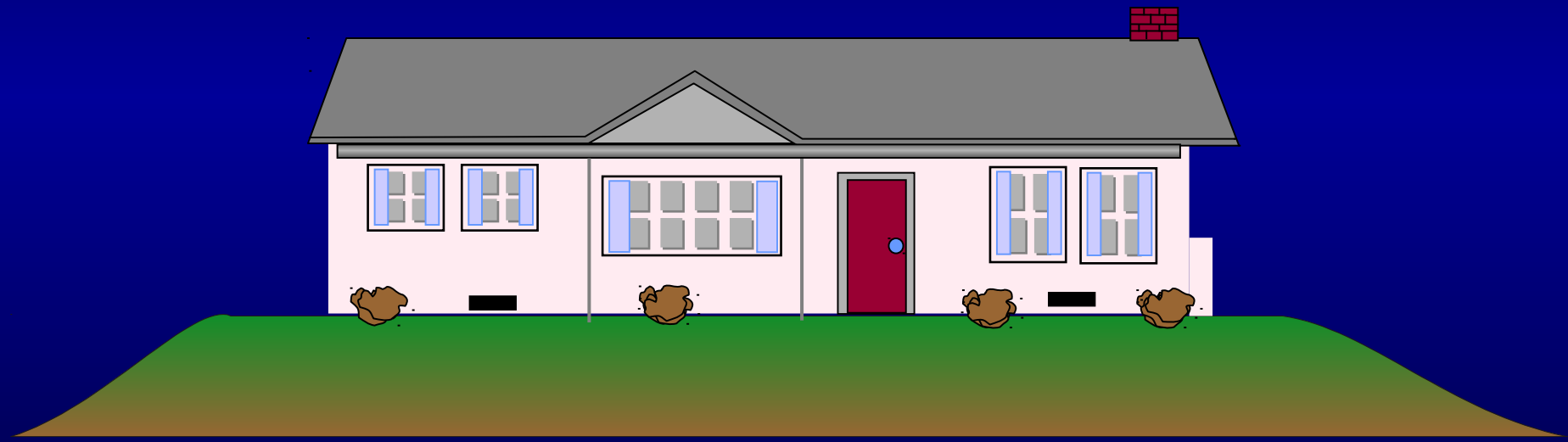
- **Elevation**
- **Relocation**
- **Floodwalls, Levees and Berms**
- **Buyout/Acquisition**
- **Dry Flood Proofing**
- **Wet Flood Proofing**
- **Flooding Warning/Preparedness**
- **National Flood Insurance Program**

Elevating on Extended Foundation Walls



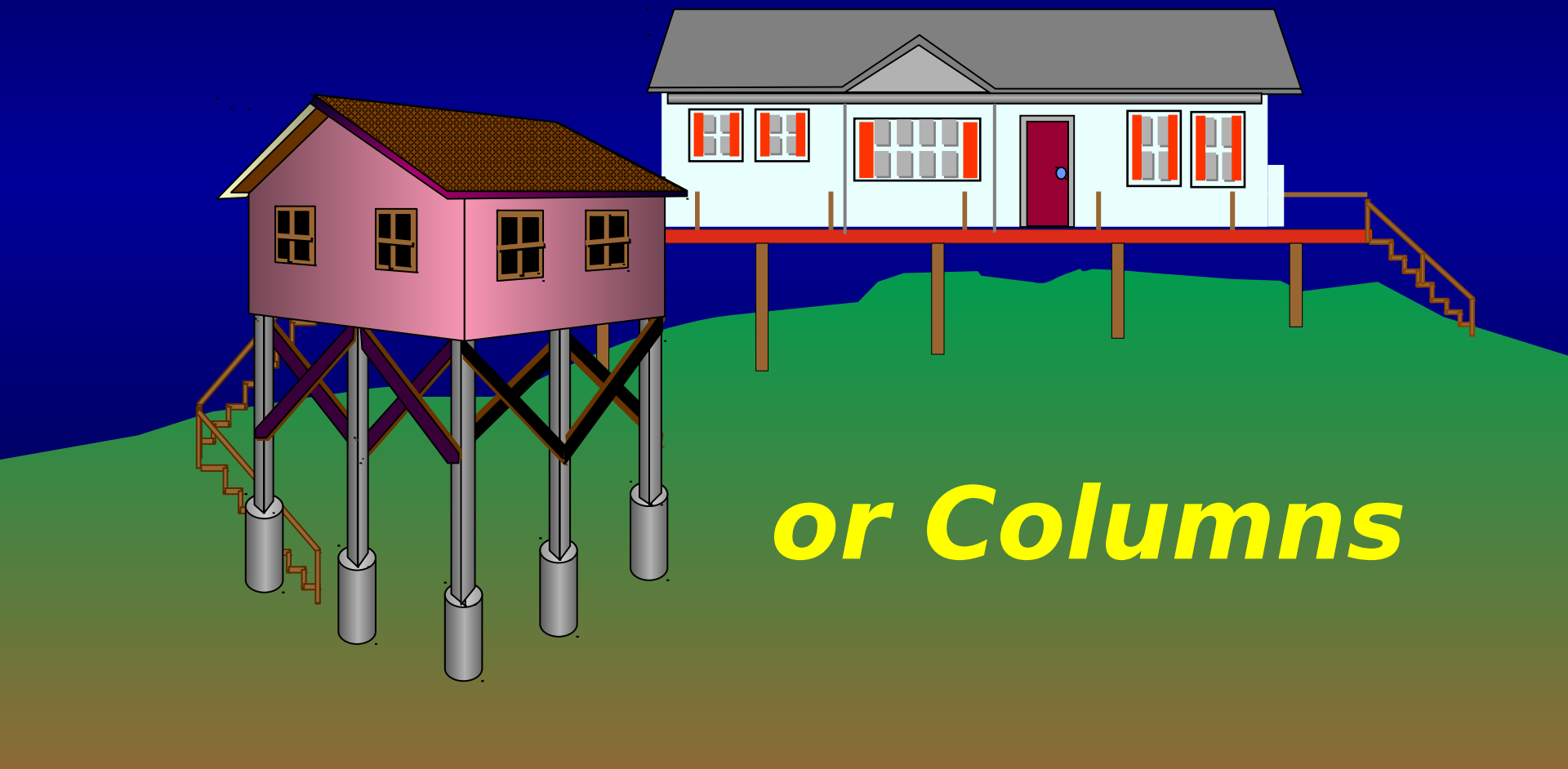
Elevating on Extended Foundation Walls

Elevating on Fill



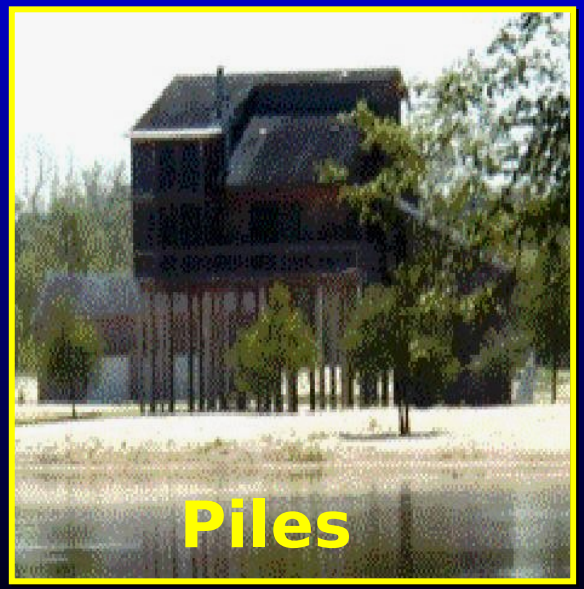
Elevating on Fill

Elevating on Piers, Posts, Piles…



or Columns

Elevation on Piers, Posts, Piles, or Columns



Nonstructural Measures

- Elevation
- **Relocation**
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- Dry Flood Proofing
- Wet Flood Proofing
- Flooding Warning/Preparedness
- National Flood Insurance Program

Relocation Process
Moving the Structure

- Evacuate temporary roadway
- Attach structure to trailer
- Transport structure to new site

Relocation Process

Restoration of Old Site

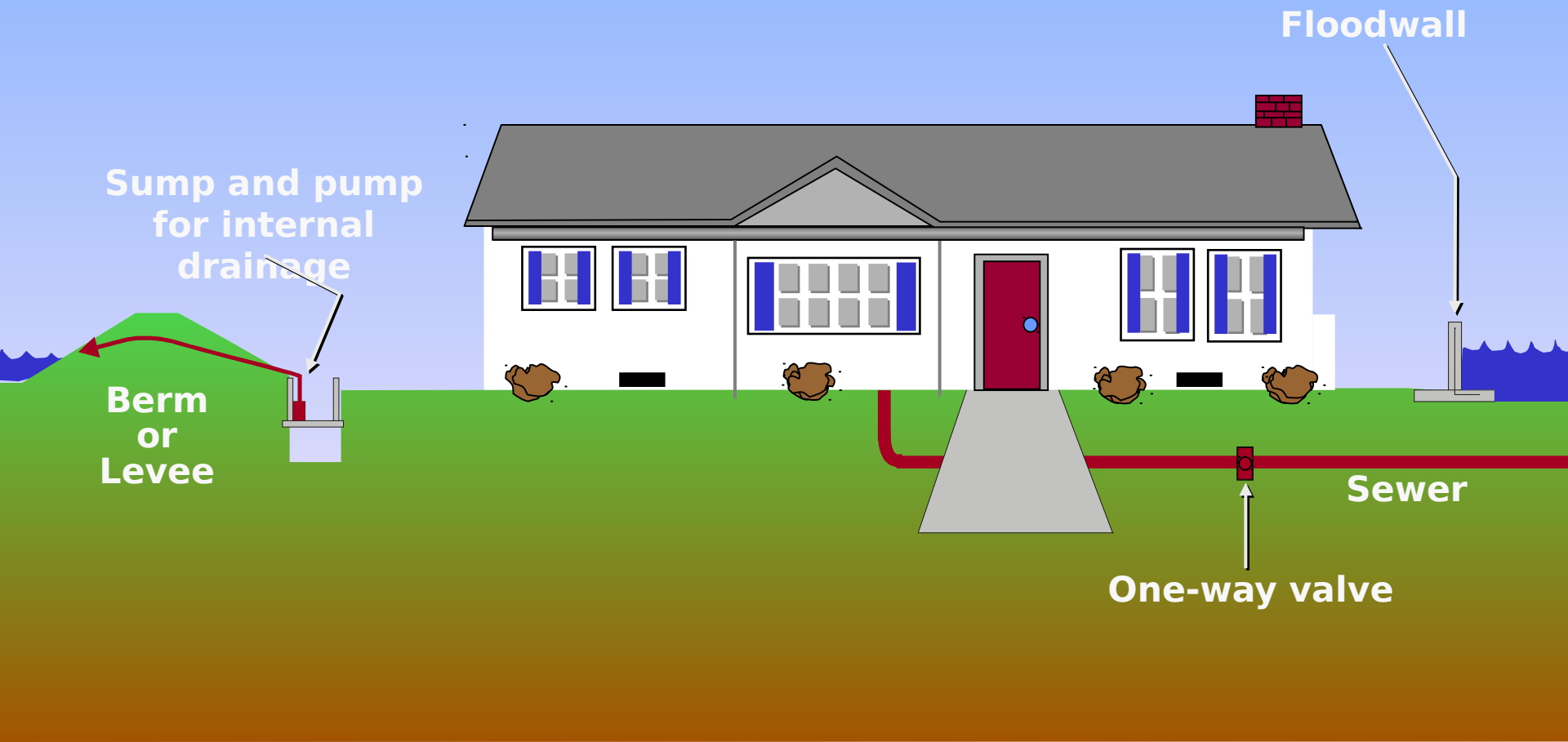
- Demolish and remove foundation and pavement
- Disconnect and remove all utilities
- Grading and site stabilization

Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- Dry Flood Proofing
- Wet Flood Proofing
- Flooding Warning/Preparedness
- National Flood Insurance Program

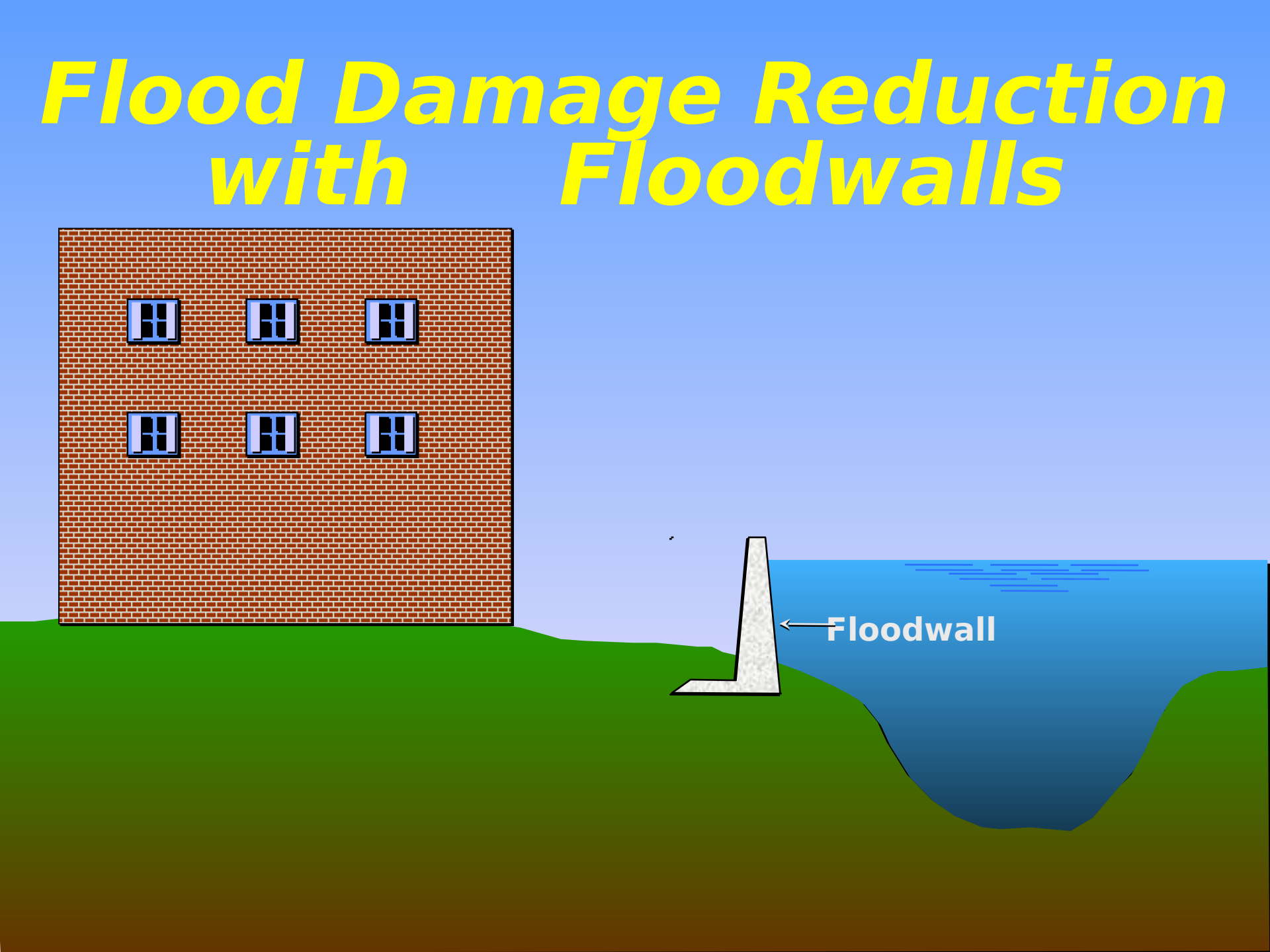
Construction Barriers

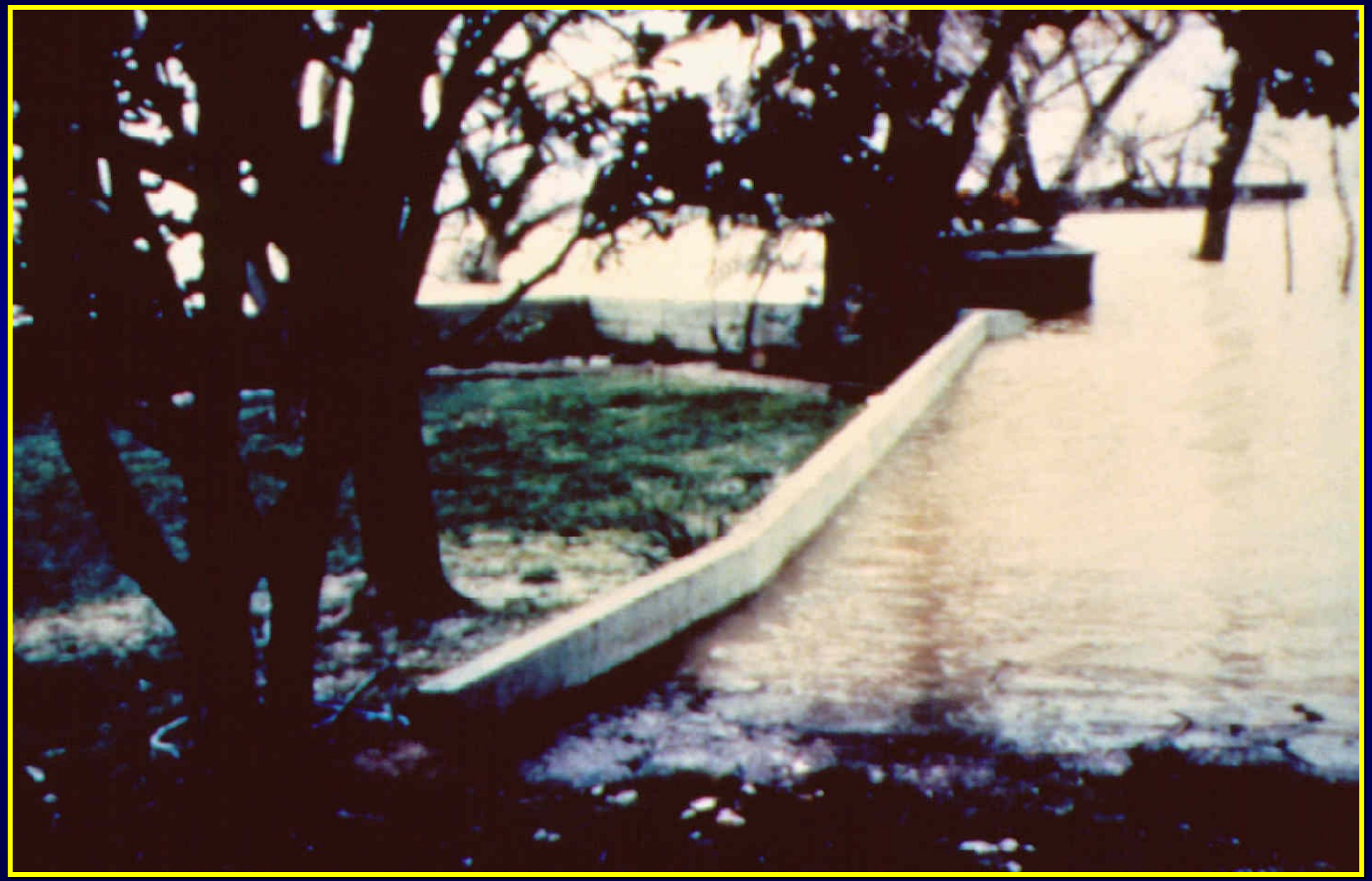
Berms, Levees and Floodwalls



Three Foot Earthen Levee

Flood Damage Reduction with Floodwalls





Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- **Buyout/Acquisition**
- Dry Flood Proofing
- Wet Flood Proofing
- Flooding Warning/Preparedness
- National Flood Insurance Program

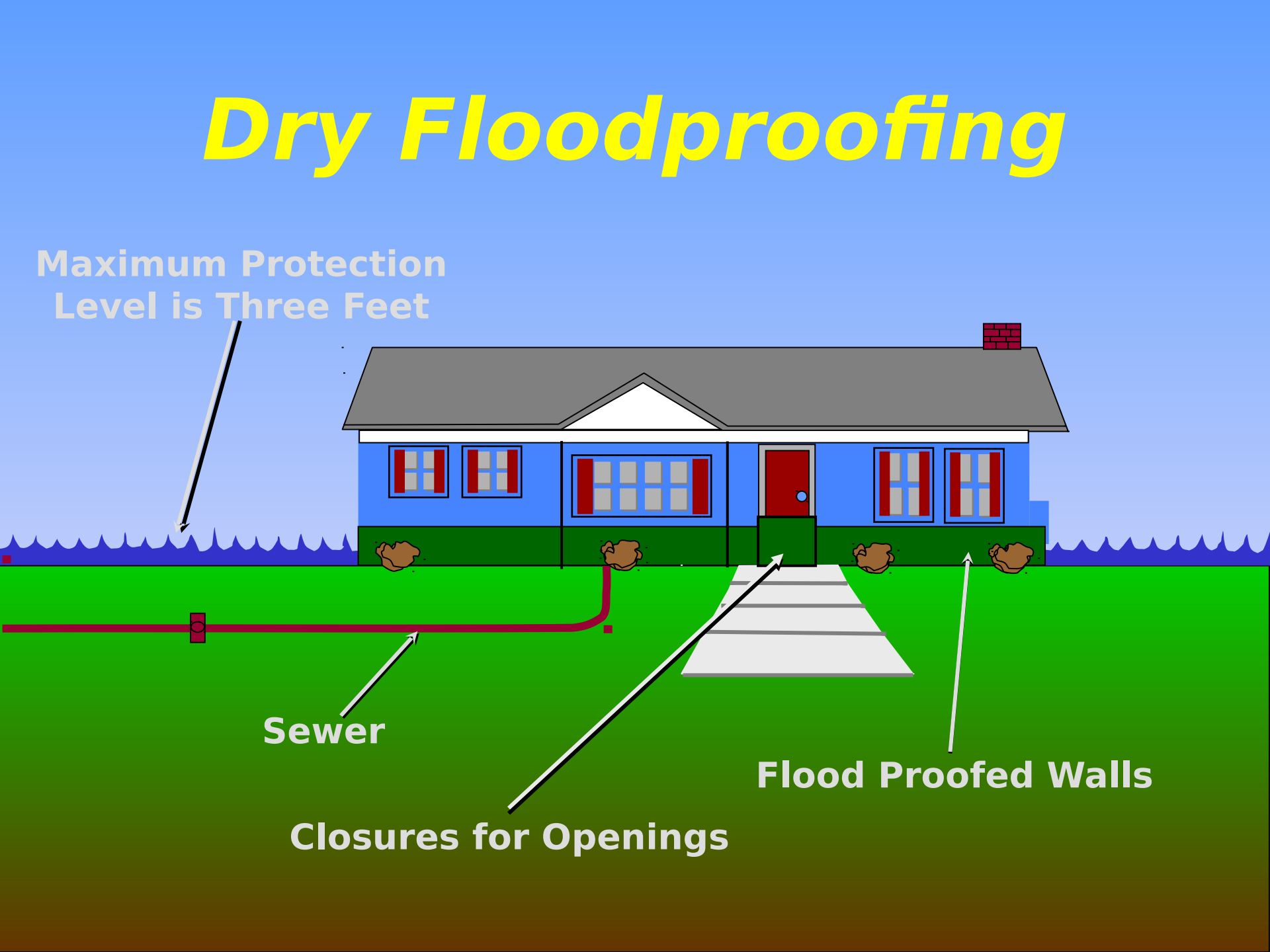
Basic Acquisition

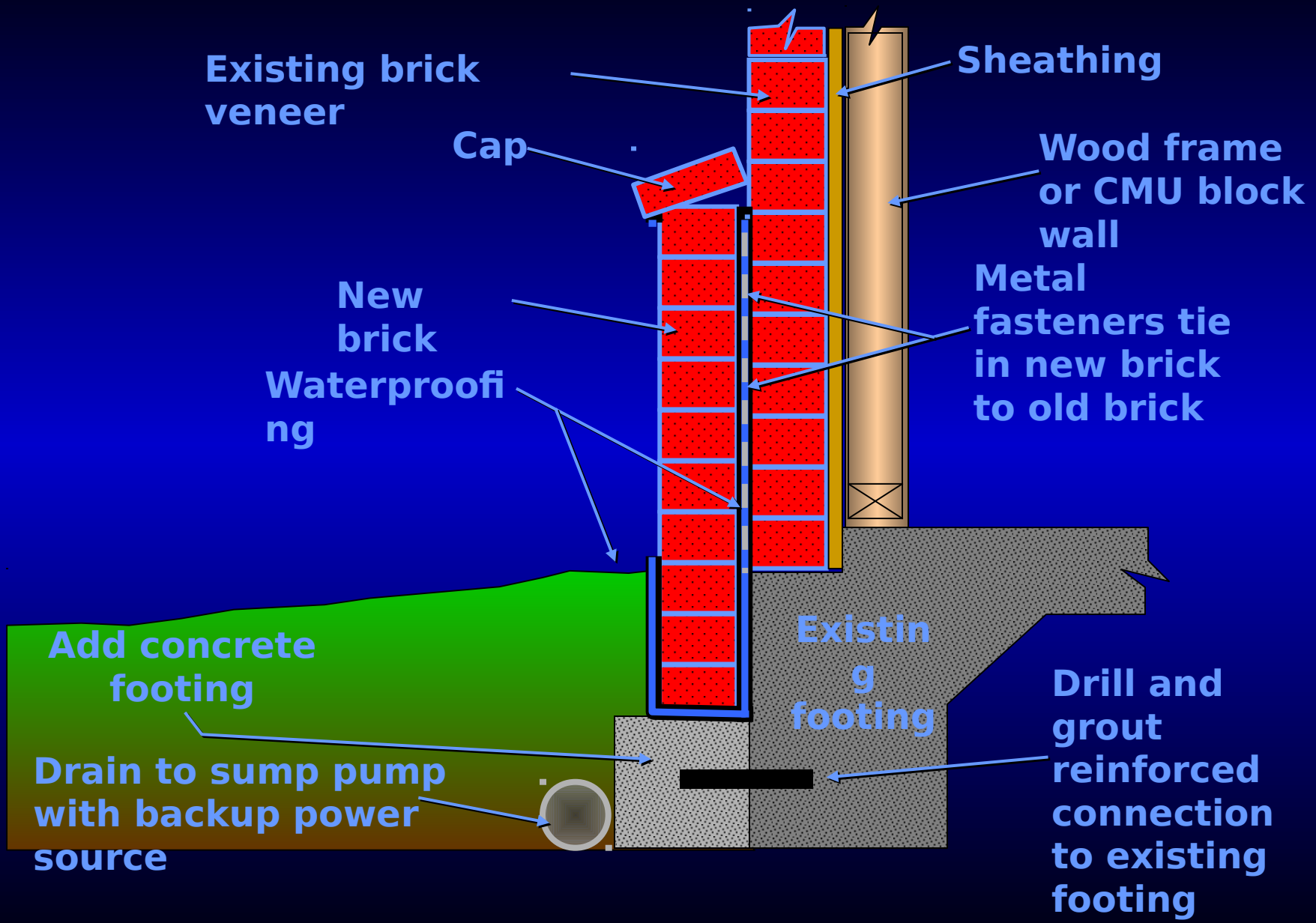
- Acquire land and structures
- Demolish structures
- Easiest type of acquisition

Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- **Dry Flood Proofing**
- Wet Flood Proofing
- Flooding Warning/Preparedness
- National Flood Insurance Program

Dry Floodproofing




Existing brick veneer
Cap
Sheathing
Wood frame or CMU block wall
New brick
Waterproofing
Metal fasteners tie in new brick to old brick
Add concrete footing
Existing footing
Drain to sump pump with backup power source
Drill and grout reinforced connection to existing footing

Dry Flood Proofing Methods
Waterproof Sealant
Seala
nt

Dry Flood Proofing Methods
Waterproof Sealant
Sealant
Veneer

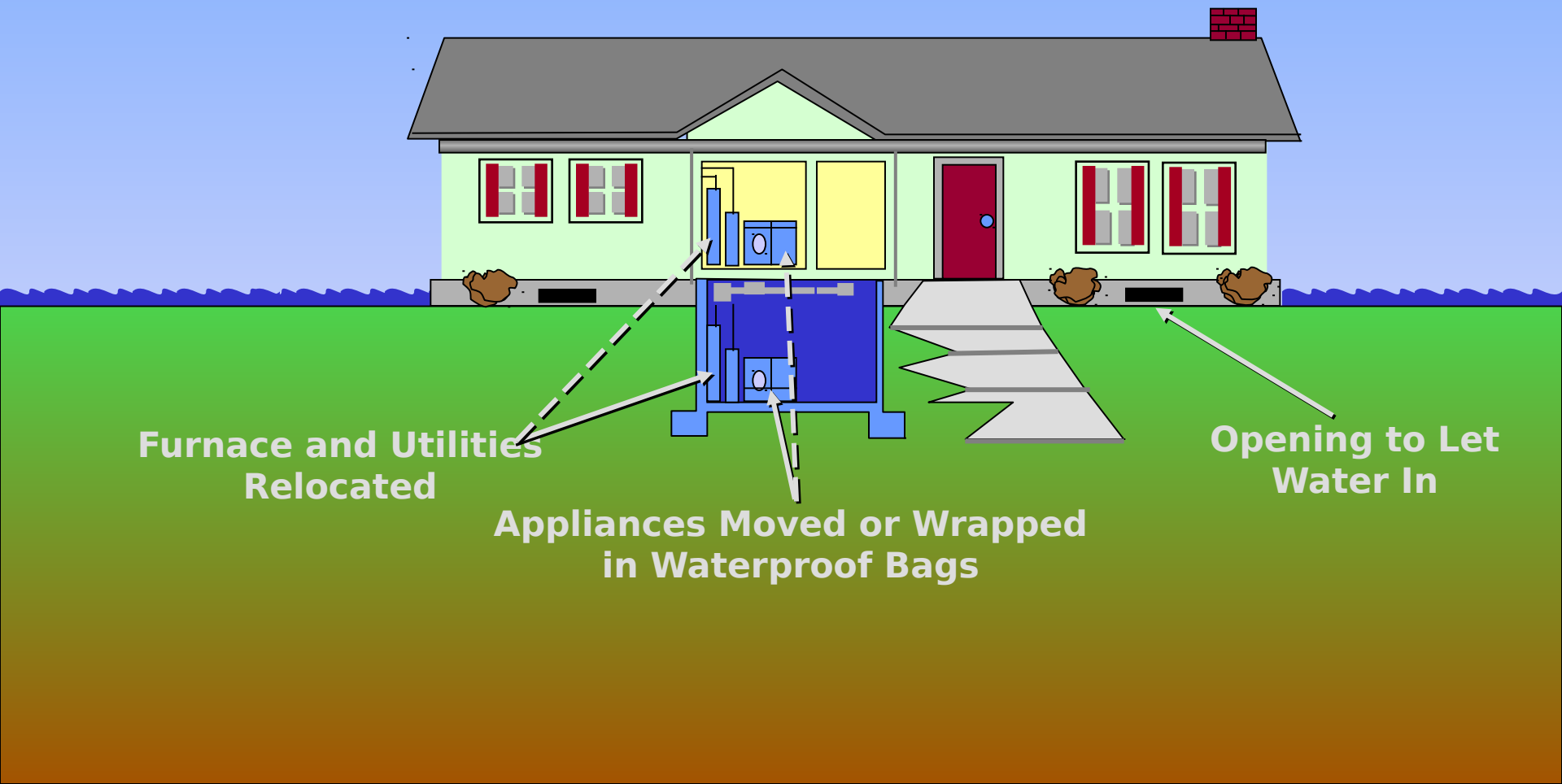
Impervious Membrane
Basebo ard
Trench

2 feet of water in back of house

Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- Dry Flood Proofing
- **Wet Flood Proofing**
- Flooding Warning/Preparedness
- National Flood Insurance Program

Wet Flood Proofing



Wet Flood Proofing

Elevate Utilities

Wet Flood Proofing
Elevate

Wet Flood Proofing

Let Water In

Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- Dry Flood Proofing
- Wet Flood Proofing
- **Flooding Warning/Preparedness**
- National Flood Insurance Program

Flood Warning/Preparedness Components

- Flood Threat Recognition System
- Warning Dissemination
- Emergency Response
- Post-Flood Recovery
- Continued Plan Management

Flood Warning/Preparedness Components

Flood Threat Recognition System

- Collection of information
- Transmission of Information
- Receipt of information
- Organization/Display of information
- Prediction or timing and magnitude of flood event

Flood Warning/Preparedness Components

Warning Dissemination

- Determine affected areas
- Identify affected parties
- Prepare warning message
- Distribute warning message

Flood Warning/Preparedness Components

Emergency Response

- Temporary evacuation
- Search and rescue
- Mass care
  ce
- Public
  prop
  protection
- Flood fight
- Maintenance of vital services

Flood Warning/Preparedness Components

Post-Flood Recovery

- Evacuee return
- Debris clearance
- Return of services
- Damage assessment
- Provisions for assistance

Flood Warning/Preparedness Components

Continued Plan Management

- Public Awareness/Education Programs
- O&M equipment
- Periodic drills
- Update plan

Flood Warning System

Alert

- Remote rain and stage gages
- Transmit information
- Base station computer
- Process information
- Automated threatened area notification (most advance systems)

Automated Stage Detection

- Float switch/submersed electric circuit activated by rising water
- Telephone automatic alarm dialers activated
- Calls placed to emergency managers
- Manual threatened area notification

Hybrid

- Combination of Alert and USGS stream gaging methods and equipment
- Remote rain and stage gages
- Transmit information
- Base station computer or two way telephonic communication with gages
- Manual or automated threatened area notification

Manual

- Observer read stage or rain gages.
- Two way telephonic communication between observers and emergency managers
- Manual threatened area notification

Nonstructural Measures

- Elevation
- Relocation
- Floodwalls, Levees and Berms
- Buyout/Acquisition
- Dry Flood Proofing
- Wet Flood Proofing
- Flooding Warning/Preparedness
- National Flood Insurance Program

National Flood Insurance Program 44CFR 59-78

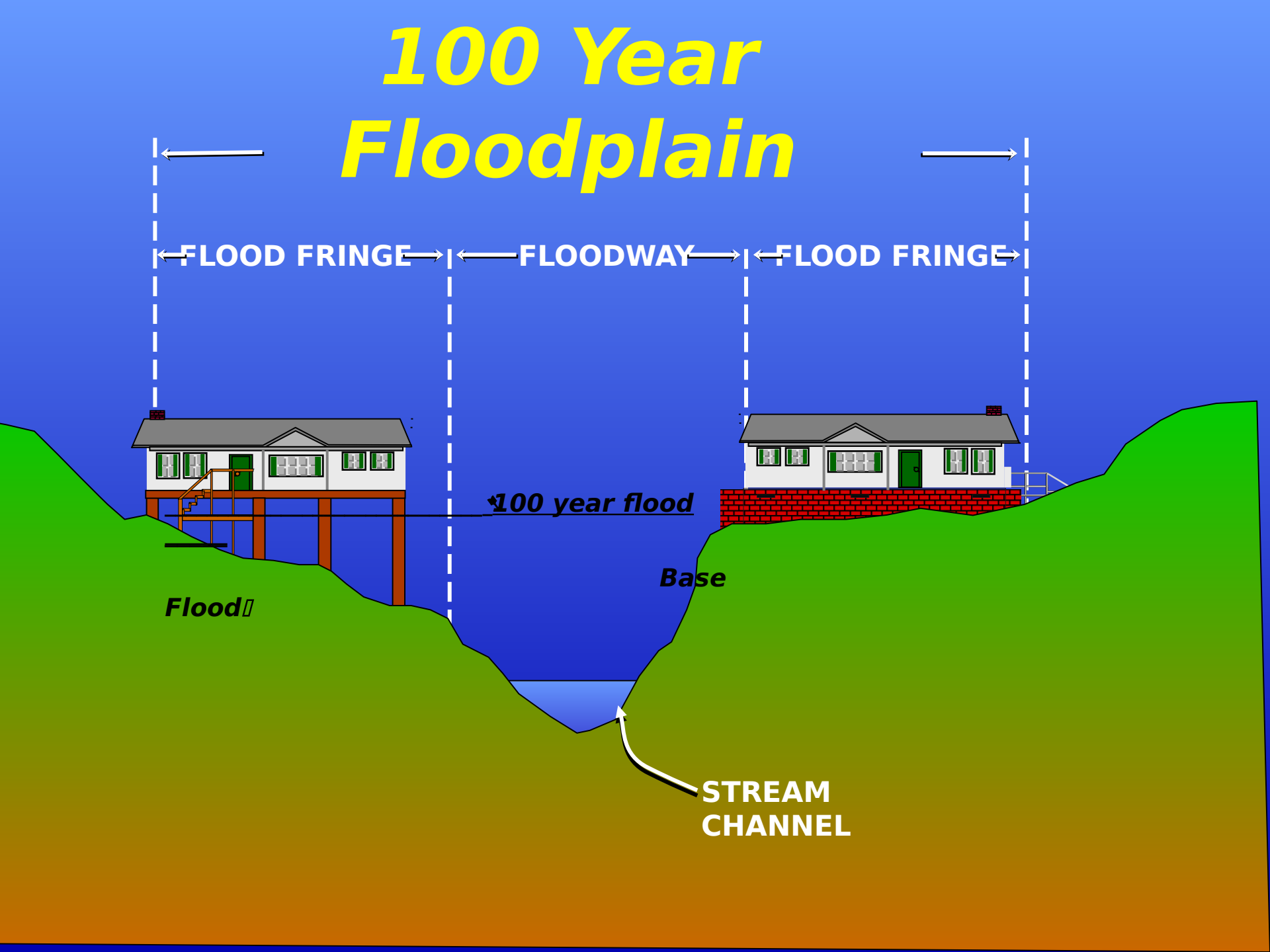
- Flood Plain Regulation, 44 cfr 60
- Flood Insurance
- Flood Mitigation
  - HMGP
  -

National Flood Insurance Program 44 CFR 59-78

Flood Plain Regulation 44 CFR 60

- Definitions
  - Base Flood
  - Flood
  - Flood Plain
  - Floodway

100 Year Floodplain



Hazard Mitigation Grant Program

- Project criteria
  - Conform with hazard mitigation plan
  - Be cost effective
  - Conform with flood plain management criteria
  - Have a beneficial impact on the designated disaster area
  - 75/25 cost share
- Types of projects
  - Structural
  - Nonstructural
  - Acquisition/relocation
  - Develop state and local mitigation standards
  - Develop comprehensive hazard mitigation programs with implementation as an essential component
  - Develop or improve warning systems

- **Flood Mitigation Assistance Programs**
  - **Planning grants**
    - **Develop flood hazard mitigation plans**
    - **75/25 cost share**
  - **Project grants**
    - **Implement flood mitigation projects contained in the flood hazard mitigation plan**
    - **75/25 cost share**
  - **Technical assistance grants**
    - **To aid applicants in applying for the FMA Program**
    - **100/0 cost share**

- Community Rating System
  - Credible activities
    - Public Information
      - Elevation certificates
      - Map information
      - Outreach programs
      - Hazard Disclosure
      - Flood protection library
      - Flood protection assistance

- Flood Damage Reduction Activities
  - Flood plain management plans
  - Acquisition and relocation
  - Retrofitting
  - Drainage

- Mapping and Regulatory
  - Open space preservation
  - Higher regulatory standards
  - Flood data maintenance
  - Stormwater management

- Flood Preparedness Activities
  - Flood Warning Program
  - Levee Safety
  - Dam Safety

- Maximum flood insurance premium reduction is 45%

Why Investigate Non-Structural Measures ?

- **Requirements**
- **Opportunities**

Requirements

- Corps
  - Section 73 of WRDA 1974
    - Consideration shall be given to non-structural measures in the planning and formulation of all flood damage reduction plans
  - ER 1105-2-100
    - Non structural measures shall receive equal consideration in the planning process to structural measures
- Sponsor
  - More and more sponsors are requiring

Opportunities

- No Adverse Impacts
  - Flood Plain
  - Environmental
- Complies with E.O. 11988
- Complies with NFIP Regulations
  - HMGP acquired land
  - Insurable structures/Fill in floodway

Opportunities (cont.)

- New Uses of the Evacuated Flood Plain
  - Ecosystem Restoration
  - Recreation
  - Spillover Benefits
- Water Quality Improvement
- Recreation Costs - 50% versus 10%
- Cost Sharing
  - 35% / 65%
- Lower Cost - Possible
- Mitigation of Adverse Effects of

Opportunities (cont.)

- Achievement of Strategic Goals
- Achievement of the Environmental Operating Principles
- Partnering
- Lower O&M Costs
- Innovation
- Leadership
- Excitement

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- **Basic Objectives**
  - Provide leadership in flood plain management
  - Avoid long and short term adverse flood plain impacts associated with projects.
  - Avoid direct and indirect support of development in the flood plain.
  - Reduce the risk of flood loss.
  - Minimize the impact of floods on health, safety, and welfare. Restore and preserve the natural and beneficial values of flood plains.
  - Involve the public throughout the flood plain management decision process.

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- **Basic Steps**
  - Determine whether the project is in 100-year or 500-year flood plain.
  - Notify the public early of a project that is proposed to be 100-year or 500-year flood plain to involve local decision makers in the decision process.
  - Identify and evaluate practicable alternatives to locating the project in the flood plain.
  - Identify the potential direct and indirect impacts with the project in the flood plain.

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- **Basic Steps**
  - **Minimize the potential adverse impacts to or within the flood plain.**
  - **Reevaluate the project to see if it is still practicable in light of the impact to others**
  - **Provide the public with the findings and explanation that the project in the flood plain is the only practicable alternative.**
  - **Provide for mitigation of adverse affects of the project.**

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- **Basic Mitigation Requirements**
  - **Land**
    - **Land that is within the regulatory floodway post-project that was not within the regulatory floodway pre-project.**
    - **Land that is within the 100-year flood boundary post-project that was not within the 100-year flood boundary pre-project.**
    - **Land that is in the pre-project floodway that has a floodway elevation post-project that is higher than the pre-project floodway elevation.**
    - **Mitigation.**

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- **National Flood Insurance Program (NFIP) Insurable Structures**
  - **Structures that are within the regulatory floodway post project that were not within the regulatory floodway pre-project.**
  - **Structures that are within the 100-year flood boundary post-project that were not in the 100-year flood boundary pre-project.**
  - **Structures that are subject to a 100-year flood water surface elevation post-project that is higher than the 100-year flood water surface elevation pre-project.**
  - **Mitigation**

EXECUTIVE ORDER 11988 – FLOOD PLAIN MANAGEMENT

- State Minimum Standards for Flood Plain Management
  - Varies from State to State
  - Are always equal to or more restrictive than that of the NFIP in terms of:
    - Flood plain regulation
      - Elevation above the BFE.
      - Allowable rise due to fill or new construction in the flood plain
    - Mitigation of adverse impacts of projects.

ENGINEERING REGULATION 1105-2-100

- Nonstructural measures shall receive equal consideration in the Planning process
- New uses of evacuated flood plain
  - Recreation
  - Ecosystem restoration
  - Recreation cost may not exceed 50% of the total project costs
  - Recreation benefits may exceed 50% of the benefits needed for project justification

ENGINEERING REGULATION 1105-2-100

- New uses of evacuated flood plain (continued)
  - Benefits from ecosystem restoration and recreation that are new uses of the evacuated flood plain are considered flood damage reduction
  - Land costs applicable to ecosystem restoration should not exceed 25% of total project costs
  - Recreation and ecosystem restoration, if considered incidental to the primary purpose of flood damage reduction, can be cost

ENGINEERING REGULATION 1105-2-100

- Relocation/buyout is justified by:
  - Value of the new use of the evacuated flood plain
  - Reduction in damage to public property
  - Reduction in emergency costs
  - Reduction in administrative costs of the NFIP and disaster relief
  - Total flood damage reduced
  - Spillover benefits
- Two or more structures are needed unless single property protection is part of a larger plan benefiting

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Non-Structural Plan Formulation

Plan Formulation

- **Navigation**
- **Flood Damage Reduction**
- **Hurricane and Storm Damage Reduction**
- **Ecosystem Restoration**
- **Hydroelectric Power Generation**
- **Recreation**
- **Water Supply and Water Quality**
- **Multiple Purpose and Watershed Projects**

Plan Formulation

- **Process of building alternative plans that meet your Planning objectives without violating your constraints**
- **Alternative plans consist of one or more measures**

Plan Formulation

- **Measures include:**
  - **Elevation**
  - **Relocation**
  - **Floodwalls, Levees and Berms**
  - **Buyout/Acquisition**
  - **Dry Flood Proofing**
  - **Wet Flood Proofing**
  - **Flooding Warning/Preparedness**
  - **National Flood Insurance Program**
- **An iterative process that identifies structural and/or non-structural measures that (along or in combination) can meet planning objectives**

Planning Process
Six Steps

Step 1
Identify Problems And Opportunities

Step 2
Inventorying and Forecasting Conditions

Step 3
Formulating Alternative Plans

Step 4
Evaluating Alternative Plans

Step 5
Comparing Alternative Plans

Step 6
Selecting A Plan

Plan Formulation

- **The formulation process seeks to develop alternative plans that have:**
  - **Completeness – the extent to which the alternative plans provide and account for all necessary actions to ensure the realization of the planning objective.**
  - **Effectiveness – the extent to which the alternative plans contribute to achieve the planning objectives.**

Plan Formulation

- **The formulation process seeks to develop alternative plans that have:**
  - **Efficiency – the extent to which an alternative plan is the most effective means of achieving the objectives.**
  - **Acceptability – the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies. Appropriate mitigation of adverse effects shall be an integral component of each alternative plan**

Formulation Phases

- **Identify measures: define the building blocks that address the planning objectives.**
- **Formulate alternative plans or programs: mix and match measures; consider combinability and dependency.**
- **Iterate: do it over again.**

Plan Formulation

- **Plans formulated must contribute to the Federal objective to contribute to National Economic Development (NED) consistent with protecting the Nation's environment (EQ), in accordance with national environmental status, applicable executive orders and other Federal planning requirements. Other optional objectives may be to contribute to Regional Economic Development (RED) and Social Well Being (SWB).**

Plan Formulation

- **National Economic Development account displays changes in the economic value of the national output of goods and services**
- **Environmental Quality account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans**

Plan Formulation

- **Regional Economic Development account displays changes in the distribution of regional economic activity**
- **Other Social Effects account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others**

Plan Formulation

- **Display of the National Economic Development and Environment Quality accounts is required. Display of the Regional Economic Development and other Social Effects accounts is discretionary**

Comparing Alternative Plans

- **Measure how well plans meet objectives and constraints**
  - **Cost Effectiveness**
  - **Dollar Costs**
  - **Benefits (Quantifiable and non-quantifiable)**
  - **Adhere to Laws and Public Stakeholders and Public Opinions**

Trade-off Analysis

- **Trade-off analysis helps you compare many different efforts. While there are many techniques to help identify trade-off, final judgment boils down to people’s subjective reference for one effect or another**

Keys to Successful Non-Structural

Plan Formulation

- **Candid investigation of problems**
- **Communication within PDT and Sponsor**
- **Comprehensive and concise PMP**
- **Motivated and Empowered Project Delivery Team**

Keys to Successful Non-Structural Plan Formulation

- **Be open-minded**
- **Review and learn from your past experiences**
- **Encourage others to participate in the Process;**
  - **Stakeholders**
  - **Agencies**
  - **Sponsors**
  - **Individuals**
  - **Team Members**

Keys to Successful Non-structural Plan Formulation

- **Use informed judgment and personal intuition of experience of people**
- **Perform an objective evaluation of alternative plans**

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Non-Structural Projects Across the C

Project - ***Pentz Run***

District - Pittsburgh

Location - DuBois, Pennsylvar

Authority - General Investigat

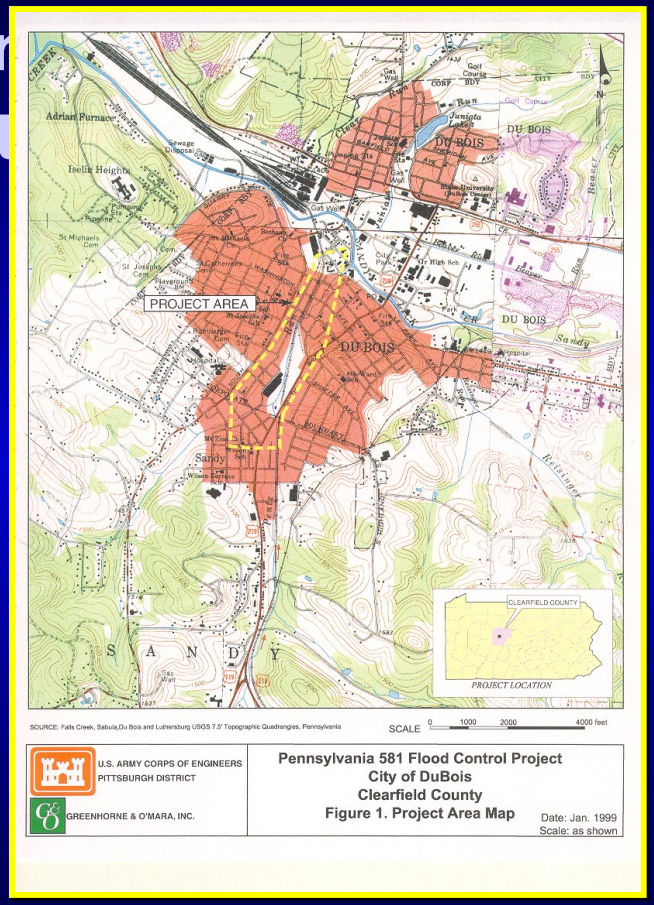
Non-Structural Measures

- Acquisition
- Dry Flood Proofing
- Elevation
- Relocation
- Flood Warning
- Wet Flood Proofing

Economics - Flood Damage Reduction

BCR - n/a

Status - Feasibility



Project - ***Tug Fork Basin***

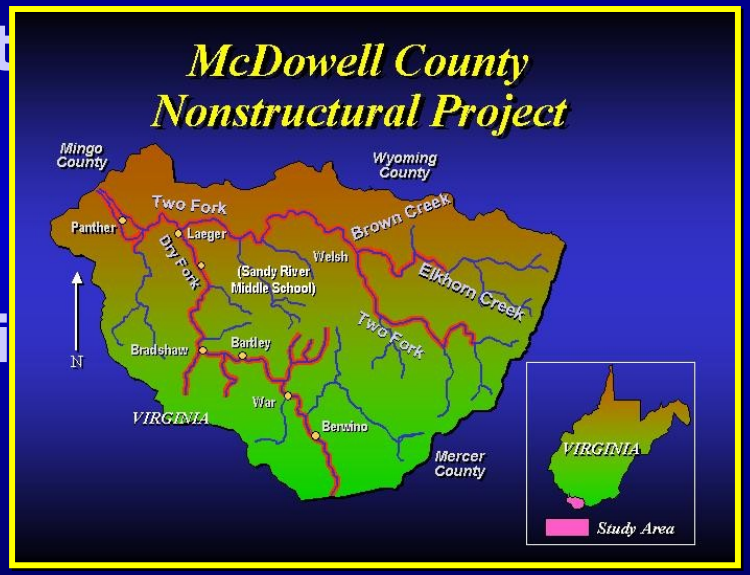
District - Huntington

Location - McDowell County, West Virginia

Authority - General Invest

Non-Structural Measures

- Elevation
- Dry Flood Proofi
- Acquisition
- Flood Warning
- Wet Flood Proofing



Economics - Flood Damage Reduction

BCR - n/a

Status - Implementing

Project - ***Johnson Creek***

District - Ft. Worth

Location - Arlington, Texas

Authority - General Investigation

Non-Structural Measures - Acquisition

Economics - Flood Damage

Project - ***Spring Creek***

District - Nashville

Location - East Ridg
Tennessee

Authority - General
Investigati

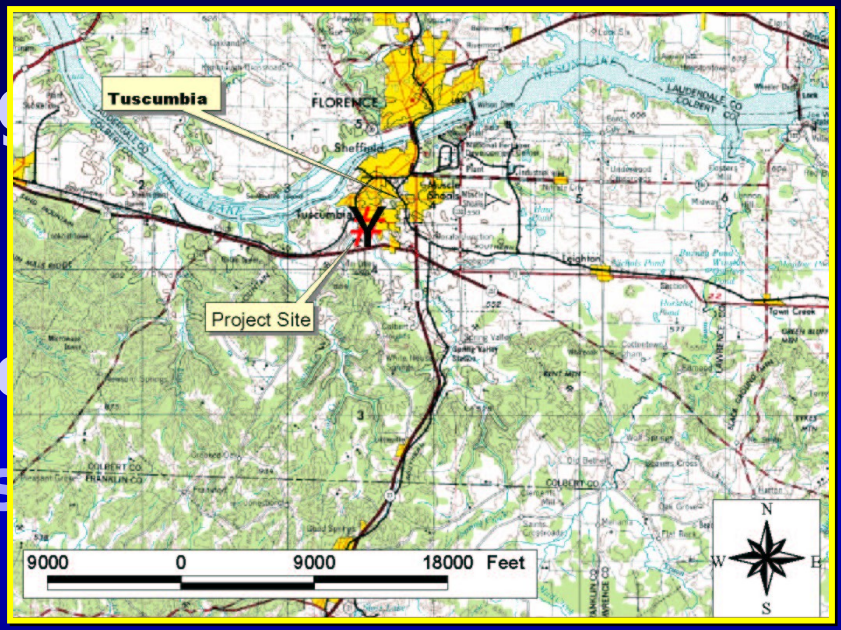
Non-Structural Meas

- Elevation
- Flood Warning

Economics - Flood Damage Reduction

BCR - 1.1

Status – No Local Sponsor



Project - ***Mill Creek***

District - Upper Moreland Township

Location - Montgom

Pennsylvania

Authority - Section 2

Non-Structural Meas

-

Economics - Flood Damage

Reduction

BCR - 1.2

Project - ***Missouri River***

District - Omaha

Location - Pierre/Fort Pierre, South Dakota

Authority - General In

Non-Structural Measur

- Acquisition
- Relocation
- Elevation
- Wet Flood Proofing

Economics - Hydropower

BCR - 2.1

Status - Implementing

Project - ***Middle Creek***

District - Sacramento

Location - Lake County, California

Authority - Public Law 8

Non-Structural Measure - Acquisition

Economics - Flood Dam Reductio

BCR - 1.3

Status - Feasibility Rep Approved, PED to Start

Project - ***Paxton Creek***

District - Baltimore

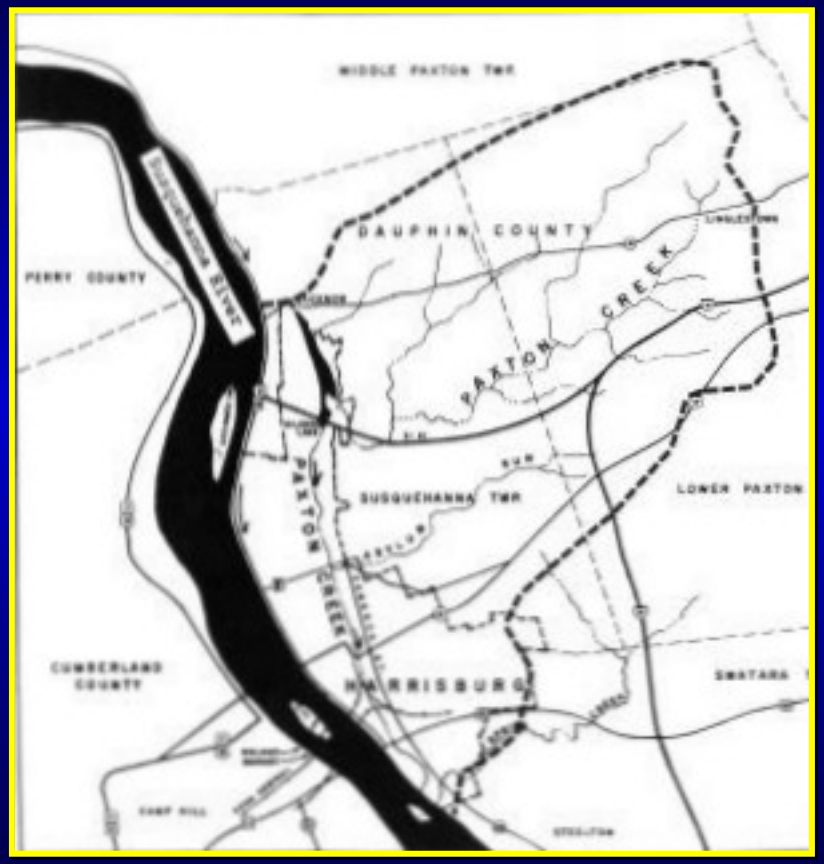
Location - Harrisburg, Pennsylvania

Authority - Section 205

Non-Structural Measures - Flood Warning System

Economics - Flood Damage Reduction

BCR - 7.4



Project - ***Vermilion River***

District - New Orleans

Location - Lafayette Parish, Louisiana

Authority - General Investig

Non-Structural Measures

- Dry Flood Proofing
- Elevation

Economics - Flood Damage Reduction

BCR - 1.7

Status - Project Terminate Due to Implementation of Comprehensive Project

Project - ***Cypress Creek***

District - Galveston

Location - Harris County, Texas

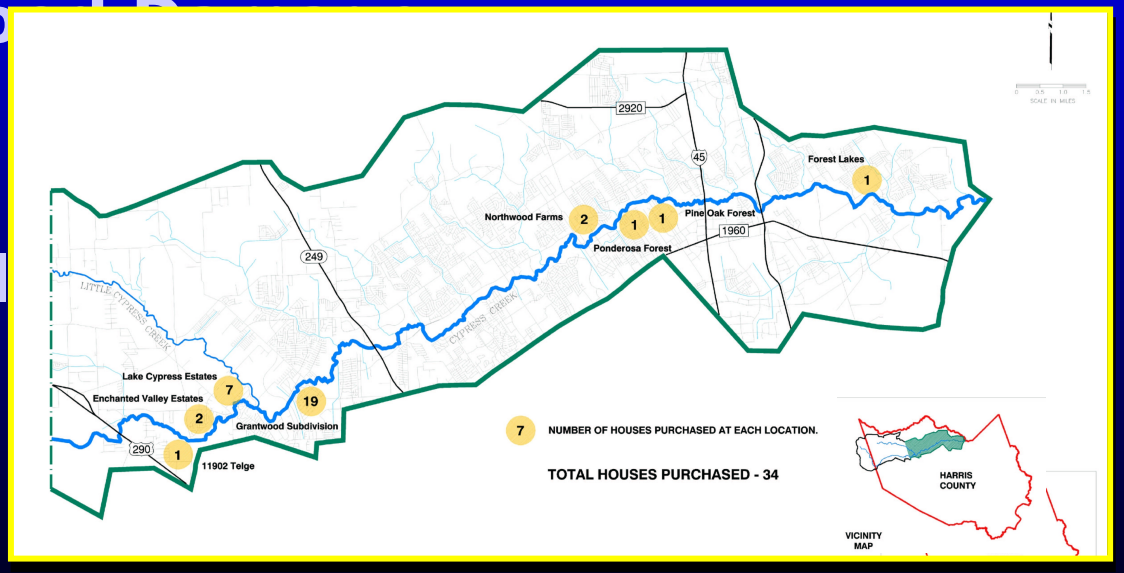
Authority - General Investigation

Non-Structural Measures - Acquisition

Economics - Flo… Reduction

BCR - 1.1

Status - Compl…



Project - ***Cold Brook***

District - Omaha

Location - Hot Springs, South Dakota

Authority - Section 205

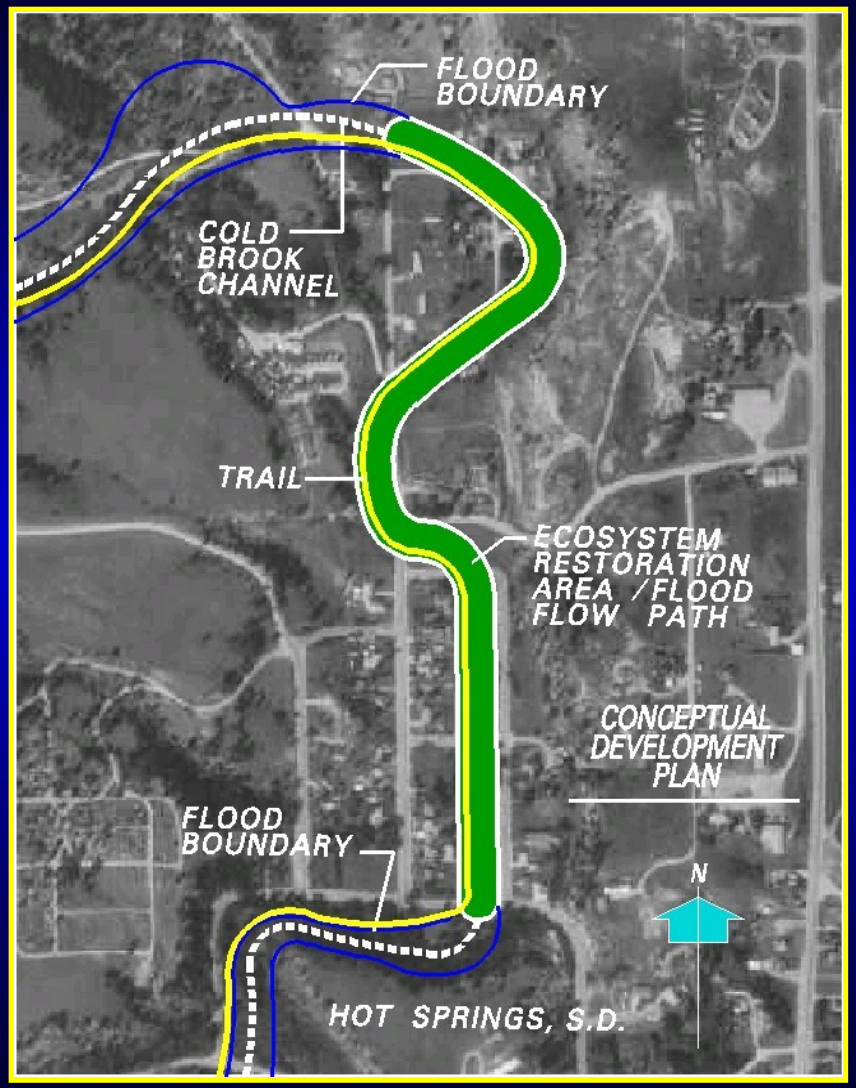
Non-Structural Measures

- Acquisition

Economics

- Flood Damage Reduction

- Recreation



Project - ***Yellowstone River***

District - Omaha

Location - Glendive, Montana

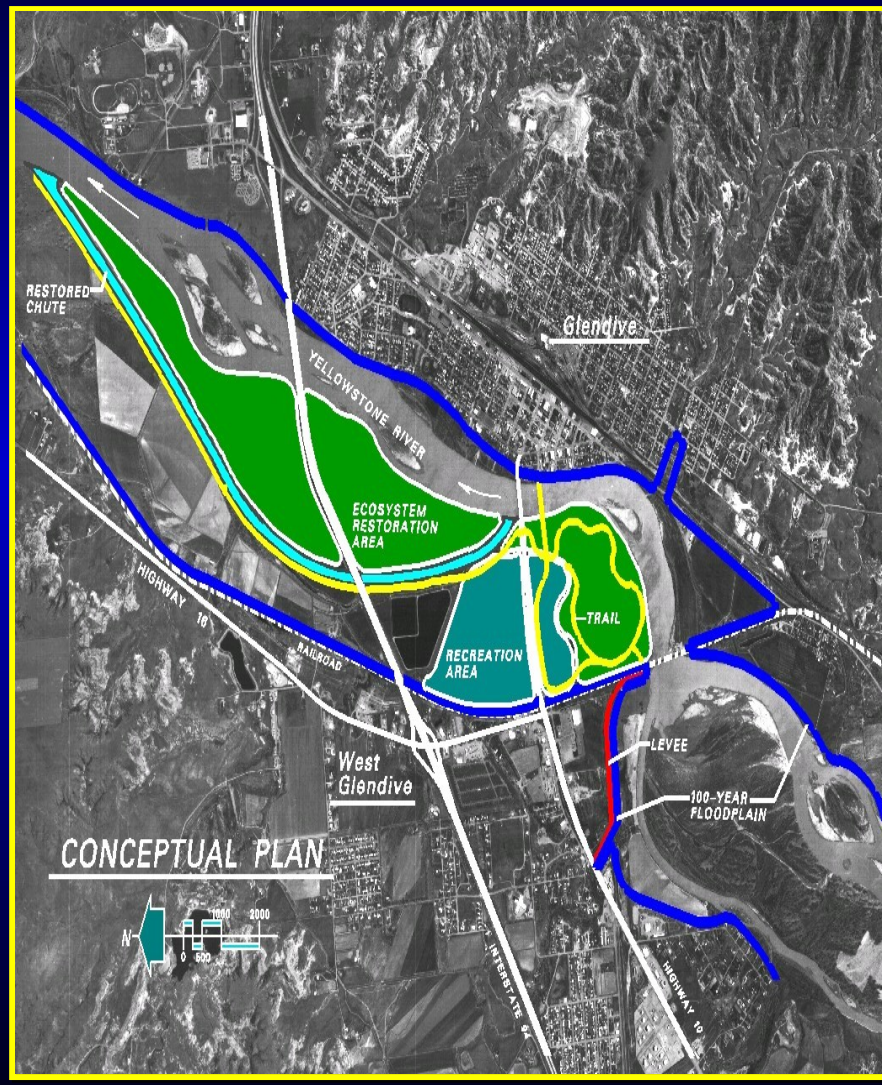
Authority - General Investigation

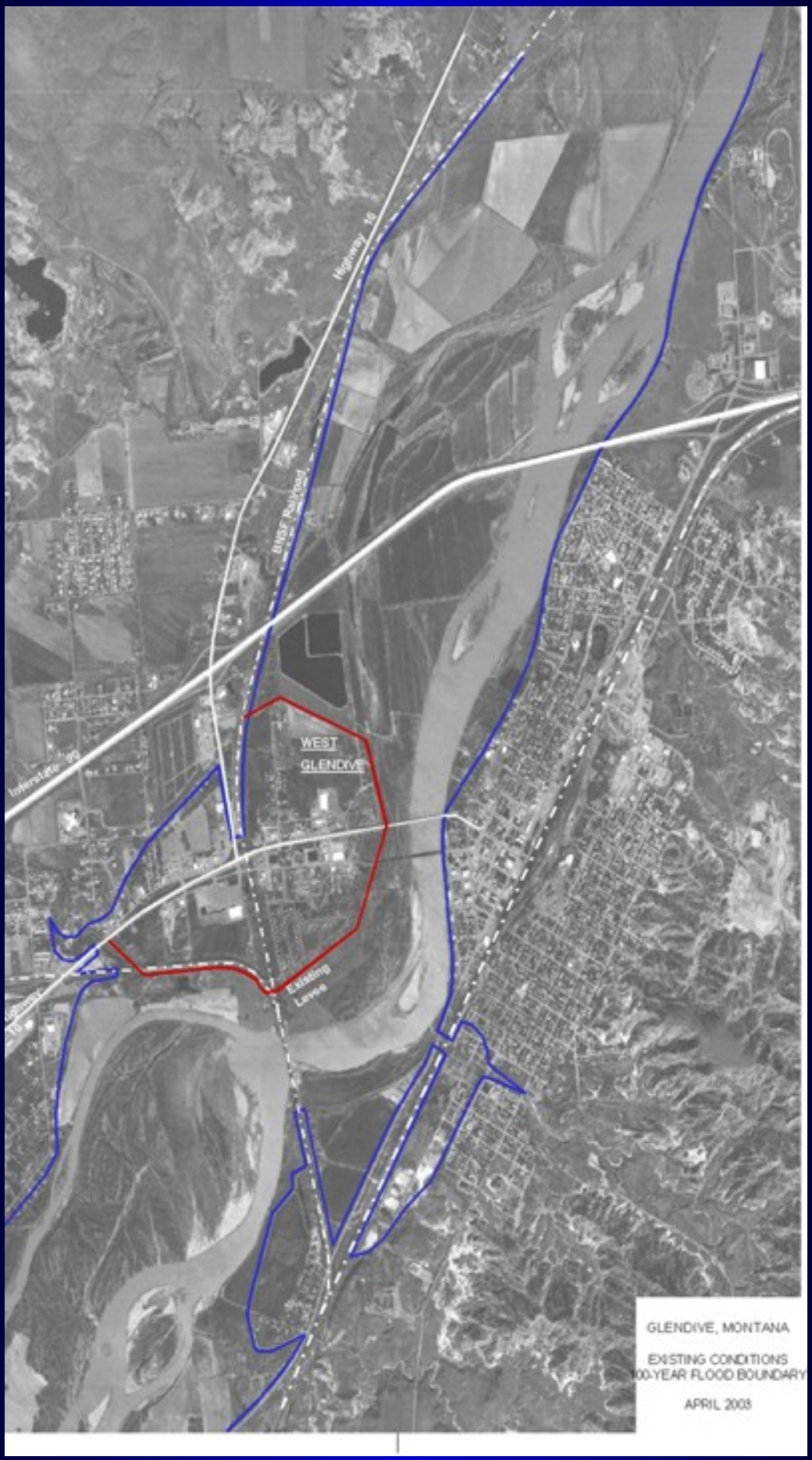
Non-Structural Measures

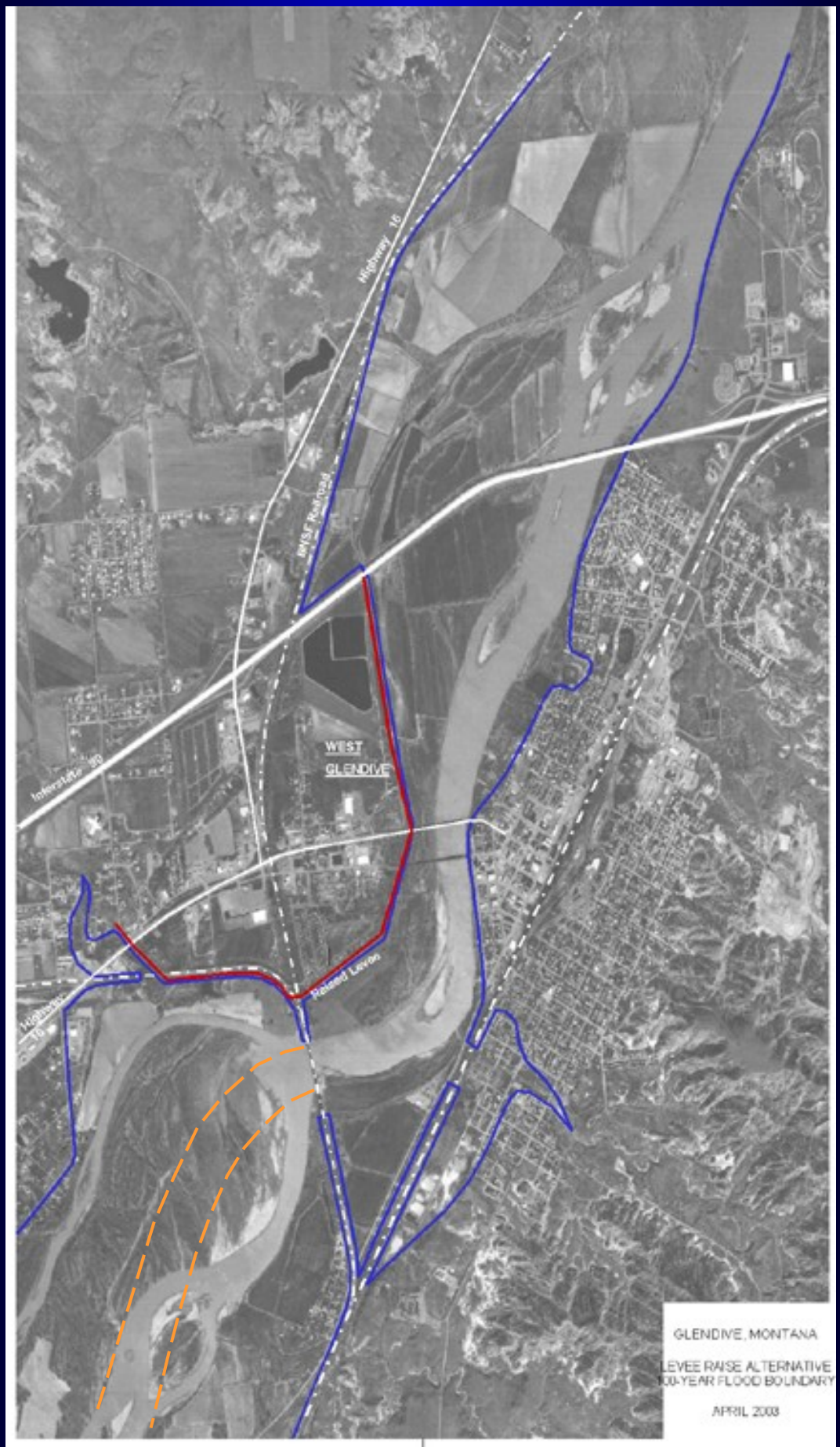
- Relocation
- Acquisition

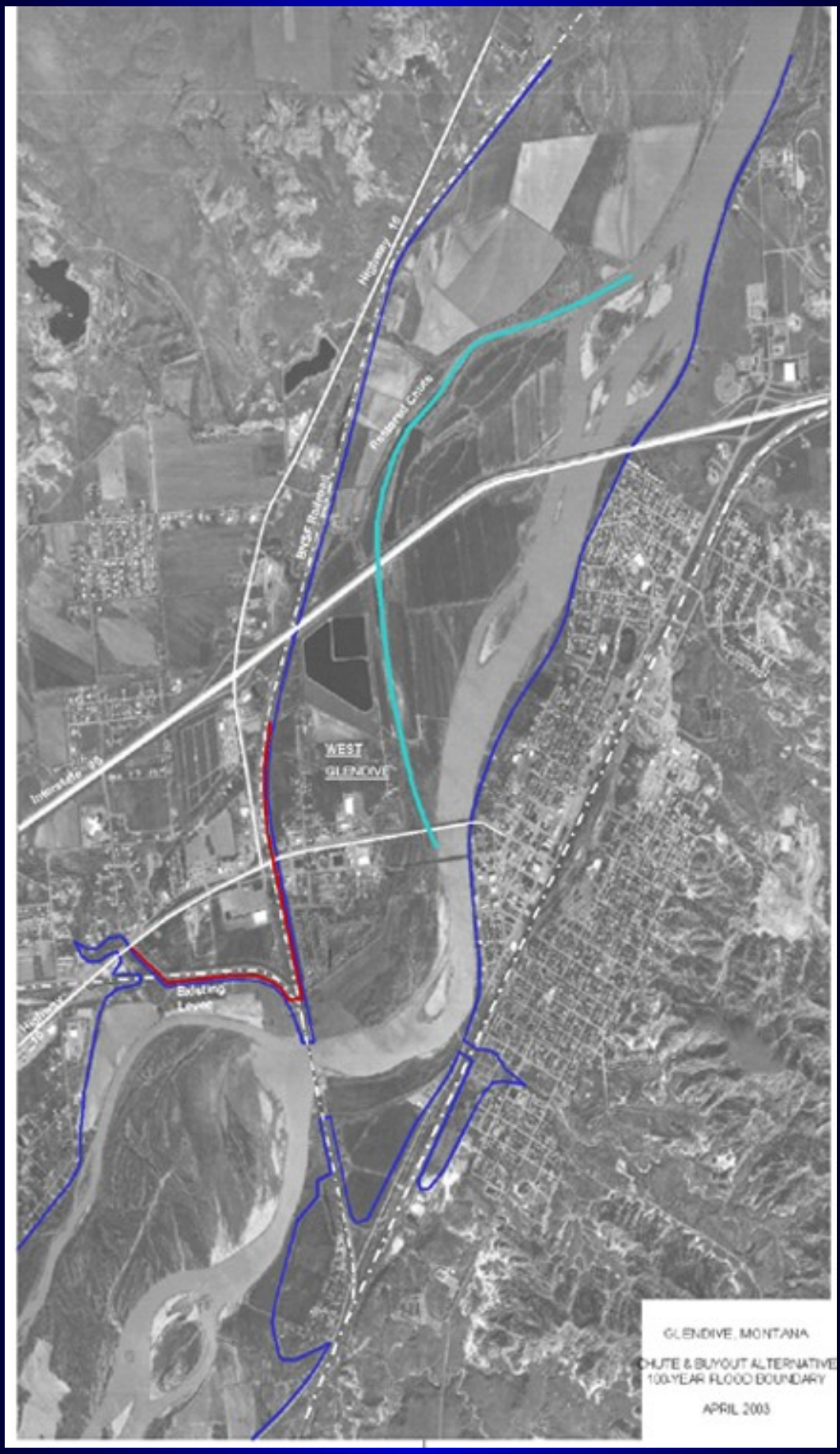
Economics

- Flood Damage Reduction
- Recreation
- Ecosystem Restoration



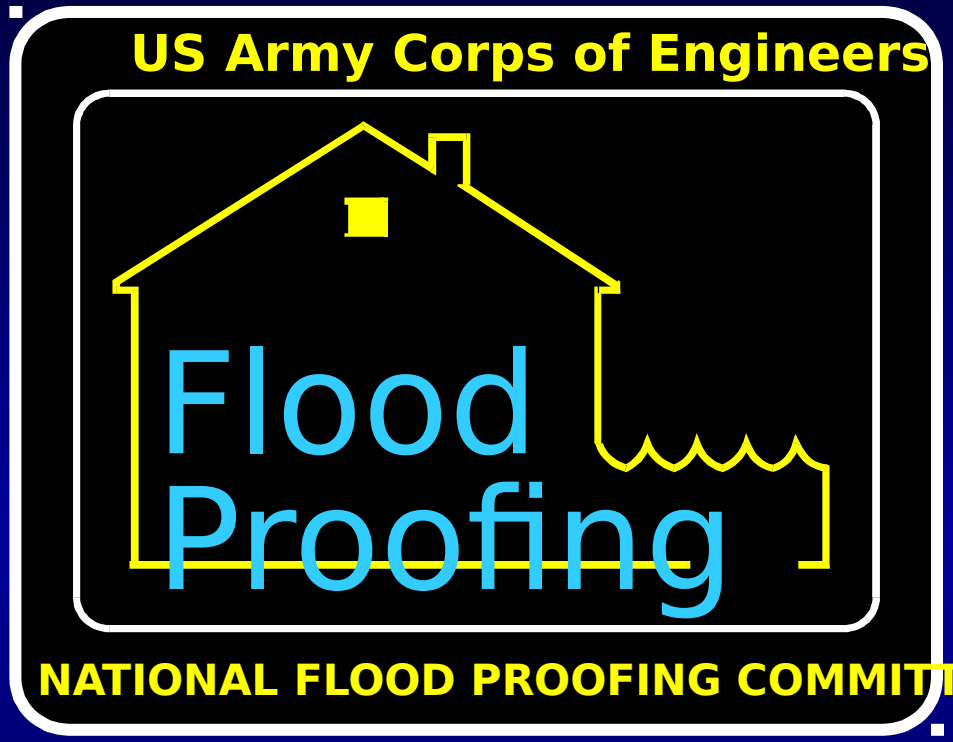

Highway 16
BNSF Railroad
WEST
GLENDIVE
Existing
Levee
GLENDIVE, MONTANA
EXISTING CONDITIONS
100-YEAR FLOOD BOUNDARY
APRIL 2003


Highway 16
BNSF Railroad
WEST
GLENDIVE
Interstate 94
Highway 16
Raised Levee
GLENDIVE, MONTANA
LEVEE RAISE ALTERNATIVE
100-YEAR FLOOD BOUNDARY
APRIL 2008


Highway 16
BNSF Railroad
Relocated Canal
WEST
GLENDIVE
Interstate 94
Existing
Levee
Highway 16
GLENDIVE, MONTANA
CHUTE & BUYOUT ALTERNATIVE
100-YEAR FLOOD BOUNDARY
APRIL 2003

Key Words to Provide Focus

- **Opportunities**
- **Impacts**
- **Innovation**
- **Challenges**
- **Excitement**



U.S. Army Corps of Engineers
National Flood Proofing Committee